

# PHYSIOLOGICAL & THERAPEUTICAL.

## ABSORPTION

### BY THE HUMAN SKIN.

BY

S. COULL MACKENZIE, M.D.,

HOUSE SURGEON, MEDICAL COLLEGE HOSPITAL, CALCUTTA.

~~~~~

ABSORPTION by the Human Skin is a subject of considerable importance, whether we regard it from a physiological or a therapeutical point of view ; yet those writers who treat of it are not agreed among themselves as to whether the human skin does really absorb or not. On the affirmative side we find the following :—

Before the close of last century Abernethy and Falkner performed a series of experiments, the results of which led them to the conclusion, that substances in solution were absorbed by the skin.<sup>1</sup> Dr. Wm. Wood discusses the subject at length, and arrives at the same conclusion.<sup>2</sup> Bracount states as the result of his observations that, after baths the urine was always increased in quantity, and that whether the water of the bath had been alkaline or acid, the urine

---

1. Currie's *Medical Reports*, p. 205. *Liverpool*, 1798.

2. *Chapter on Absorption*, in his *Essay on the Structure and Functions of the Skin*. *Edinburgh*, 1832.

always became neutral.<sup>1</sup> Dr. Robley Dunglison, Professor of Materia Medica, University, Maryland, United States, writes thus:—"J. Bradner Stuart found after bathing in infusions of madder, rhubarb, and turmeric, that the urine was tinged with these substances;" and that "Thomas Sewall found the urine colored, after bathing the feet in infusions of madder, and the hands in infusions of madder and rhubarb."<sup>2</sup> Dr. Madden in his "Graduation Thesis" (University of Edinburgh, in 1837) gives the result of a series of experiments he tried chiefly on his own person. He stated that in nearly every case he obtained an increase of his weight after taking a bath, in one instance to the extent of five drachms. Having immersed his whole arm and forearm in a solution of iodide of potassium for an hour and a quarter on four successive days, he found traces of it on testing his urine. In experimenting on his own person with infusions of rhubarb, jalap, and gamboge, he produced purgative effects.<sup>3</sup> Müller, in his "Elements of Physiology" says,—“The skin covered with epidermis, however, is certainly endued with absorbing power; but substances to be absorbed must be either in solution or readily soluble in animal fluids.” “All metallic preparations rubbed into the skin, have the same action as when given internally, only in a less degree.”<sup>4</sup> Dr. Carpenter says—"It has been found that after bathing in infusions of madder, rhubarb, and turmeric, the urine was tinged with these substances.  
 . . . . . Many saline substances are absorbed by the skin when applied to it in solution."

---

1. *Revue Medicale*, August, 1833, cited by Fardel sur les *Eaux Minerales*, p. 37. Paris, 1857.

2. *Human Physiology*, p. 68. Philadelphia, 1836.

3. *British and Foreign Medical Review*, p. 339, 1838.

4. Müller's *Elements of Physiology*, translated by Wm. Baly, M.D., p. 251. London, 1838.

5. *Carpenter's Physiology*, p. 518, 1846.

M. O. Henri states that iodide of potassium penetrates the skin during a bath consisting of a very weak solution of that substance. He is of opinion that those experimenters who have obtained negative results erred in employing too strong solutions.<sup>1</sup> Dr. W. S. Kirkes, also, is in favour of the affirmative side of the question, as the following extracts will show: "Metallic preparations rubbed into the skin have the same action as when given internally, only in a less degree. . . . Vegetable matters also, if soluble, or already in solution, give rise to their peculiar effects, as cathartics, narcotics, and the like, when rubbed into the skin. . . . When simply left in contact with the skin, substances, unless in a fluid state, are seldom absorbed."<sup>2</sup>

Durian, after a series of experiments, sums up the result in the three following propositions:—

"1st.—That water of a lower temperature than that of the body was absorbed."

"2nd.—That the urine was always alkaline after a bath, whether it was alkaline or acid".

"3rd.—That substances dissolved in a bath were never absorbed—at least, if they were, they could not be detected by any test now in use."<sup>3</sup>

MM. Chevallier and Petit "have proved from direct experiments, that one-half hour's immersion in Vichy water is sufficient to modify the fluids of the economy, and cause them to pass from the natural or acid state to the

---

1. *Essai sur l'Emploi Medical et Hygienique des Bains.* Paris, 1855.

2. Kirkes' *Hand-book of Physiology*, p. 355, 1856.

3. *Archives Generales De Medicine*, p. 161 tome 7. Paris, 1856.

alkaline.”<sup>1</sup> Heidler refutes the conclusions arrived at by Lehmann of Leipzig, and maintains that saline solutions can reach the blood through the skin.<sup>2</sup> Westrumb after having bathed his forearm and foot in Prussiate of Potass, found distinct traces of it in the urine.<sup>3</sup> Dr. Willimin of Vichy tried a number of experiments in March 1863—on nine male adults—and the conclusion he arrived at was, that absorption had taken place, but that it differed in degree in different individuals under different circumstances.<sup>4</sup>

We come now to consider the authorities on the negative side of the question.

On this side we must be content to commence with Seguin, having failed to discover any earlier writer who adopts it. We find from the *Annales De Chimie*, tome XC. page 185, that Seguin tried a number of experiments both on his patients and himself. The baths consisted of various solutions including one of the salts of mercury, but in no case in which the skin was not injured, could he discover any trace of absorption (whether of air, water, or any substance dissolved in them) having taken place. Dr. Currie, of Liverpool, has given an account of some attempts he made to administer nourishment through the skin to a patient of his,—a gentleman,—who had the cardiac orifice of his stomach closed by a cancerous tumour. He had the patient’s entire body bathed in warm milk, beef-tea, &c., &c., but failed in his object. There was no increase of weight after the baths,

1. Quoted by M. Herpin, *Etudes Medicales*, &c., pp. 185 and 186. Paris, 1856.

2. Quoted by M. Henri Dors (Vevay) *De l’Emploi de la Vase dan les Bains de mer de la Sucde*, p. 44. Paris, 1861.

3. *Archives Generales de Medicine*, page 14, July, 1863.

4. *Archives Generales de Medicine*, July, August, and September, 1863.

and the patient eventually died from want of nourishment.<sup>1</sup> Joseph Klapp of Albany, New York, after trying a series of experiments, arrived at the conclusion that the human skin does not absorb. He gives it as his opinion that certain medicines produce their respective effects not through absorption, but “through the medium of sympathy.”<sup>2</sup>

Dr. N. Chapman, in his discourse on the *modus operandi* of medicines, writes as follows:—“Determined, if possible, to put this agitated question to rest, Dr. Rousseau, assisted by his friend Dr. Samuel B. Smith, has performed a series of experiments, many of which I witnessed, and therefore bear testimony to their accuracy, with every variety of substances, mild and acrid, volatile and fixed, nutritive, medicinal, and poisonous.”

“The result of these extensive researches is”—

“1. That of all substances employed, madder and rhubarb are those only which affect the urine, the latter of the two the more readily enters the system. Neither of the articles can be traced in any other of the secretions or excretions, or in the serum of the blood.”

“2. That the power of absorption is limited to a very small portion of the surface of the body. The only parts, indeed, which seem to possess it, are the spaces between the middle of the thigh and hip, and between the middle of the arm and shoulder. Topical bathing with a decoction of rhubarb or madder, poultices of these substances applied to the back or abdomen, or sides or shoulders, produced no

---

1 Currie's *Medical Reports*, p. 247. *Liverpool*, 1789.

2 *Chemico-physiological Essay*, pp. 34 & 35. *Philadelphia*, 1805.



change in the urine, equally ineffectual was the immersion of the feet and hands in a bath of the same materials, which after being kept in it for several hours, not the slightest proof of absorption was afforded."

"As I have described, such is the state in which this interesting subject is at present left. Though perhaps not absolutely decided, enough surely has been done to demonstrate that cuticular absorption rarely happens, and that whenever it does, it cannot be deemed the effort of a natural function." <sup>1</sup>

Durand Fardel, writing in 1851 on the mineral waters of Vichy, says he does not believe in their absorption by the skin, and that they have no effect on the urine. <sup>2</sup> Lehmann of Leipzig, writing in 1855, states that he was not able to detect any trace of the saline substances which are contained in the mud baths of Marienbad, in the secretion of persons who had used them. Consequently, he infers that the skin does not absorb. <sup>3</sup> In 1855, Dr. V. Kletzinsky of Vienna published an account of certain experiments he had tried. The results of which led him to conclude that the skin does not absorb. The following account of his mode of procedure is given by Dr. Murray Thomson, in his paper read before the Royal Society of Edinburgh, 1862: "His forearm and hand were carefully cleaned and washed, and then bathed in a solution containing a known weight of iodide of potassium.

"The baths were taken before breakfast, after active exercise, which produced sweating. Each bath lasted for two hours. After the bath, the following secretions were

---

<sup>1</sup> *Discourses on the Elements of Therapeutics and Materia Medica*, pp. 56 and 57, by N. Chapman, M.D. Philadelphia, 1817.

<sup>2</sup> *Des Eaux de Vichy*.

<sup>3</sup> Schmidt's *Jahrbucher*, Vol. VIII., p. 105.

examined for iodine. The tears, saliva, nasal mucus, urine, and the serum from a blister raised by cantharides for the purpose of the experiment. The tests used would have detected one-millionth of a grain of iodine, had such been present in any of the fluids examined, but in none was a positive indication obtained.

“To demonstrate further the non-absorption of the salt after each bath, the forearm and hand were well rinsed with distilled water; these washings were mixed with the water of the bath, and the whole evaporated to dryness. If absorption had taken place, the weight should now have been less than the weight of the iodide used; but instead of that it was greater. Dr. Kletzinsky explains the increase to be owing to exosmosis of salts from the blood.”

Homolle could detect no trace of iodine after baths of iodide of potassium or of cyanuerets or hydrocyanic acid, after baths of ferrocyanide of potassium. <sup>1</sup> Braune could detect no iodine in the urine after foot baths of iodide of potassium and of iodine, when the evaporation of iodine and absorption through the lungs were prevented by a layer of oil on the water of the bath. <sup>2</sup>

There is an article on baths in the *British and Foreign Medical Review*, January, 1859. When treating of the Medical Bath the author states, it was his opinion that “the substances dissolved in the baths are not absorbed through the skin.” The last authority I shall quote is Dr. Murray Thomson, lately Lecturer on Chemistry in Edinburgh, now Professor of Experimental Science, Thomason College,

---

<sup>1</sup> *British and Foreign Medico-Chirurgical Review*, p. 144, January, 1859.

<sup>2</sup> *British and Foreign Medico-Chirurgical Review*, p. 145, January, 1859.

Roorkee. In his paper on the absorbing powers of the human skin in the *Edinburgh Medical Journal*, 1862, he details certain experiments he had tried, and declares himself very decidedly in favour of the non-absorbing theory.

Finding from a perusal of the chief authorities on the subject, of which, in the foregoing pages, I have given an outline, that the question as to whether or not the human skin absorbs, was still in dispute, I deemed it one to which I might profitably turn my attention. With the view of arriving at some definite conclusion, I determined on trying a series of experiments. And being impressed with the idea that some of these writers had drawn a general conclusion from very inadequate premises, I determined to try the experiments, not only with different substances but on different individuals, and, so far as was practicable, under various circumstances. With this view, I requested three of my friends (A, B, and C) and a porter (F) to take certain of them. I likewise requested one of the nurses of the infirmary to collect and give me the urine of one of the patients (E). Having thus secured that the experiments should be tried on four adults (including myself D) in the prime of life, and two lads, I considered that I had laid a sufficiently broad basis to warrant a sound conclusion. My next endeavour was to obtain a sufficient number of substances of different kinds. Having secured twelve of these, I proceeded to use them in different forms, some in baths, both for the whole body and also only for the feet; others as applications to particular parts of the body. I also varied, so far as circumstances would permit, the temperature of the baths, and the quantities of the substances dissolved in them. I further arranged that the baths should be taken at different hours, both of the day and night; sometimes



after long fasting, at other times soon after a full meal. The quantity of the substances used was carefully weighed and dissolved. Care was taken to note the time the person was in the bath, also the temperature of the water, and, so far as was possible, the quantity of it employed. In the first twenty the whole body, except the head and neck, was immersed, and no precaution was taken to avoid inhaling the vapour.

The experiments and their results are exhibited in the annexed Table with reference to which it will be advanced.

(1.) That in those where iodide of potassium was the substance experimented on, no trace of iodine was detected either in the urine or the saliva.

(2.) That with regard to the effects of caustic soda, the urine of the persons who took these baths was acid or normal previous to taking the bath. In the case of B there is no doubt that the caustic soda was absorbed by the skin. With the view of placing the matter beyond doubt, I got him to try two additional experiments. The result proved that this reaction was not merely accidental, but that the absorbing power of his skin differed from that of C and D. These four experiments tried on him, have proved most satisfactorily the fact, that the skin does not possess this absorbing power at all times in a like degree. In No. XIII., he did not get an alkaline reaction till twenty-two and a half hours after the bath. In No. XV. he got the alkaline reaction as soon as ten minutes after the bath, then two hours afterwards, and not again till twenty-three and a quarter hours after it. In No. XIX., he got the alkaline reaction ten minutes after the bath, and then there was no return of it, though the urine was tested for thirty hours after the bath. In No. XX., he got

the alkaline reaction at seventeen and a half, and eighteen and a quarter hour after the bath, but it was very slight.

(3.) Of the experiments with Belladonna, it will be observed by reference to No. XXXI., that D's skin absorbed it. A kindly offered to try the experiment on himself, but only received a negative result, as is seen by No. XXXII. This I think is due to his having applied too small a quantity.

(4) As to Tar. This was the only other experiment in which I obtained a positive result. There can be no doubt that this substance was absorbed by the skin, as every precaution was taken to ensure a fair trial.

The conclusions to which these experiments lead me, are 1st.—That the human skin does possess the power of absorption; 2nd.—Which varies in degree, not only in different individuals, but in the same person, with time and circumstances.

---

# EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

*Baths in which the whole body was immersed.*

| Number. | Subject. | Sex. | Age. | Dates.           | Substance.                 | Quantity in<br>Grains. | Quantity of<br>water in gallons. | Temperature<br>of water. | Period of Im-<br>mersion. | Urine collect-<br>ed for hours. | Urine reduced<br>by evaporation<br>to. | Tests used.                                                                                                                                                       | Results.                   |
|---------|----------|------|------|------------------|----------------------------|------------------------|----------------------------------|--------------------------|---------------------------|---------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 1       | D.       | M.   | 22   | 19th Sept. 1863. | Ferrocyanide of Potassium. | 3000                   | 50                               | 98°                      | 1 hour.                   | 24                              | $\frac{1}{2}$                          | Perchloride of Iron.                                                                                                                                              | None could be<br>detected. |
| 2       | D.       | M.   | 22   | 21st Sept. 1863. |                            | 4000                   | 50                               | 96°                      | 1 h. 15 m.                | 24                              | $\frac{1}{2}$                          |                                                                                                                                                                   |                            |
| 3       | A.       | M.   | 26   | 21st Sept. 1863. |                            | 4000                   | 50                               | 83°                      | 40 in.                    | 24                              | $\frac{1}{2}$                          |                                                                                                                                                                   |                            |
| 4       | D.       | M.   | 22   | 28th Sept. 1863. |                            | 5000                   | 75                               | 90°                      | 1 hour.                   | 24                              | $\frac{1}{2}$                          |                                                                                                                                                                   |                            |
| 5       | B.       | M.   | 24   | 28th Sept. 1863. |                            | 5000                   | 75                               | 95°                      | 1 hour.                   | 24                              | $\frac{1}{20}$                         |                                                                                                                                                                   |                            |
| 6       | C.       | M.   | 17   | 2nd Oct. 1863.   |                            | 4000                   | 80                               | 95°                      | 45 m.                     | 24                              | $\frac{1}{2}$                          |                                                                                                                                                                   |                            |
| 7       | D.       | M.   | 22   | 12th Oct. 1863.  | Iodide of Potassium.       | 2000                   | 75                               | 95°                      | 1 hour.                   | 24                              | To near dryness.                       | Distilled with Binoxide of<br>Manganese and Sulphuric<br>Acid, received the distillate<br>into alcohol and then tested<br>with starch and chlorine<br>for Iodine. | None could be<br>detected. |
| 8       | B.       | M.   | 24   | 15th Oct. 1863.  |                            | 4000                   | 75                               | 95°                      | 1 hour.                   | 24                              |                                        |                                                                                                                                                                   |                            |
| 9       | B.       | M.   | 24   | 16th Oct. 1863.  |                            | 1000                   | 70                               | 90°                      | 1 hour.                   | 24                              |                                        |                                                                                                                                                                   |                            |
| 10      | D.       | M.   | 22   | 16th Oct. 1863.  |                            | 2000                   | 60                               | 90°                      | 1 hour.                   | 24                              |                                        |                                                                                                                                                                   |                            |
| 11      | C.       | M.   | 17   | 20th Oct. 1863.  |                            | 2000                   | 80                               | 96°                      | 45 m.                     | 24                              |                                        |                                                                                                                                                                   |                            |
| 12      | C.       | M.   | 17   | 23rd Oct. 1863.  |                            | 3000                   | 80                               | 90°                      | 1 hour.                   | 24                              |                                        |                                                                                                                                                                   |                            |

## EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

*Baths in which the whole body was immersed.*

| Number. | Subject. | Sex. | Age. | Date.           | Substance.    | Quantity in<br>Grams. | Quantity of<br>water in gallons. | Temperature<br>of water. | Period of Im-<br>mersion. | Urine collect-<br>ed for hours. | Urine reduced<br>by evaporation<br>to. | Tests used.                                                    | Results.                                                                                                                                                                 |
|---------|----------|------|------|-----------------|---------------|-----------------------|----------------------------------|--------------------------|---------------------------|---------------------------------|----------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13      | B.       | M.   | 24   | 3rd Oct. 1863.  | Caustic Soda. | 2000                  | 75                               | 95°                      | 1 h.                      | 26                              | Not evaporated.                        | Tested with Turnerte paper as soon as the urine was<br>voided. | Got a strong alkaline reaction<br>23½ hours after the bath, and<br>again a feeble reaction 26½ hours<br>after.                                                           |
| 14      | D.       | M.   | 22   | 3rd Oct. 1863.  |               | 3000                  | 65                               | 90°                      | 1 h.                      | 30                              |                                        |                                                                | Got no alkaline reaction.                                                                                                                                                |
| 15      | B.       | M.   | 24   | 5th Oct. 1863.  |               | 5000                  | 75                               | 85°                      | 1 h.                      | 40                              |                                        |                                                                | Alkaline reaction 10 minutes<br>after the bath, very decided 2 h.<br>after not so decided 23 and 25½<br>hours weakly so, very slightly so<br>at 27¼ and 30¼ hours after. |
| 16      | D.       | M.   | 22   | 6th Oct. 1863.  |               | 4000                  | 70                               | 95°                      | 1 h.                      | 31                              |                                        |                                                                | No alkaline reaction.                                                                                                                                                    |
| 17      | C.       | M.   | 17   | 11th Oct. 1863. |               | 2500                  | 90                               | 98°                      | 45 m.                     | 33                              |                                        |                                                                | Do. Do.                                                                                                                                                                  |
| 18      | C.       | M.   | 17   | 14th Oct. 1863. |               | 4000                  | 80                               | 96°                      | 45 m.                     | 34                              |                                        |                                                                | Do.                                                                                                                                                                      |
| 19      | B.       | M.   | 24   | 21st Oct. 1863. |               | 2000                  | 75                               | 95°                      | 1 h.                      | 30                              |                                        |                                                                | Urine voided 10 minutes after<br>bath, decidedly alkaline, but no<br>further reaction after.                                                                             |
| 20      | B.       | M.   | 24   | 23rd Oct. 1863. |               | 5000                  | 75                               | 95°                      | 1 h.                      | 36                              |                                        |                                                                | 17¼ and 18¼ hours after the<br>bath, very slightly alkaline<br>reaction. None before or after.                                                                           |

# EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

## Foot Baths.

| Number. | Subject. | Sex. | Age. | Date.           | Substance.      | Quantity in<br>Grains. | Quantity of<br>water in gallons | Temperature<br>of water. | Period of Im-<br>mersion. | Urine collect-<br>ed for hours. | Urine reduced<br>by evaporation<br>to. | Tests used.            | Results.  |
|---------|----------|------|------|-----------------|-----------------|------------------------|---------------------------------|--------------------------|---------------------------|---------------------------------|----------------------------------------|------------------------|-----------|
| 21      | D.       | M.   | 22   | 9th Nov. 1863.  | Turkey Rhubarb. | 960                    | 6                               | 90°                      | 1 h. 30 m.                | 12                              | Not evaporated at all.                 | Color of the urine.    | Negative. |
| 22      | B.       | M.   | 24   | 16th Nov. 1863. |                 | 980                    | 6                               | 90°                      | 2 h.                      | 12                              |                                        |                        |           |
| 23      | D.       | M.   | 22   | 17th Nov. 1863. |                 | 1920                   | 6                               | 90°                      | 2 h.                      | 12                              |                                        |                        |           |
| 24      | D.       | M.   | 22   | 11th Nov. 1863. | Madder.         | 960                    | 6                               | 90°                      | 1 h. 30 m.                | 12                              | Not evaporated at all.                 | Color of the urine.    | Negative. |
| 25      | B.       | M.   | 24   | 13th Nov. 1863. |                 | 960                    | 6                               | 90°                      | 1 h. 15 m.                | 12                              |                                        |                        |           |
| 26      | D.       | M.   | 22   | 19th Nov. 1863. |                 | 1920                   | 6                               | 90°                      | 2 h.                      | 12                              |                                        |                        |           |
| 27      | D.       | M.   | 22   | 14th Nov. 1863. | Turmeric.       | 960                    | 6                               | 90°                      | 1 h. 30 m.                | 12                              | Not evaporated<br>at all.              | Color of the<br>urine. | Negative. |
| 28      | D.       | M.   | 22   | 21st Nov. 1863. |                 | 1920                   | 6                               | 90°                      | 2 h.                      | 12                              |                                        |                        |           |



## EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

*Lotions applied to the Thigh.*

| Number. | Subject. | Sex. | Age. | Date.            | Substance.       | Strength.                 | Quantity used. | Applied for hours. | Urine collected for hours. | Reduced by evaporation to. | Tests used.                                                                                                                                                                                           | Results.                               | REMARKS. |
|---------|----------|------|------|------------------|------------------|---------------------------|----------------|--------------------|----------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|----------|
| 29      | E.       | M.   | 16   | 14th Sept., 1863 | Acetate of Lead. | 2 grs. to 1 oz. of water. | Pints 3        | 96                 | 72                         | To dryness.                | Burnt residue in a crucible and acted on the ash with NO <sub>5</sub> , dil. filtered, and evaporated, the filtrate to dry, then redissolved in HO, and passed a current of HS. through the solution. | No evidence of Lead could be detected. |          |
| 30      | D.       | M.   | 22   | 14th Oct., 1863  |                  | 10 grs. to 1 oz. of HO.   | Ounces 2       | 11                 | 24                         |                            |                                                                                                                                                                                                       |                                        |          |

*Infusions applied to the front of the thorax.*

|    |    |    |    |                   |             |                               |        |    |       |       |       |                                                              |                                                                                                                       |
|----|----|----|----|-------------------|-------------|-------------------------------|--------|----|-------|-------|-------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 31 | D. | M. | 22 | 30th Sept., 1863. | Belladonna. | 1 dr. of extract to 1 oz. HO. | 2 oz.  | 4  | ..... | ..... | ..... | 4 hours after application, pupils were considerably dilated. | Suffered from a burning sensation of the skin and had vertigo more or less severe cephalalgia for several days after. |
| 32 | A. | M. | 26 | 22nd Oct., 1863.  |             | 1 dr. E. B. 1 oz. HO.         | 6 drs. | 12 | ..... | ..... | ..... | Pupils unaffected.                                           |                                                                                                                       |

# EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

## *Tinctures applied to the thorax.*

| Number. | Subject. | Sex. | Age. | Date.            | Substance. | Strength.       | Quantity used. | Applied for hours. | Urine collected for hours. | Reduced by evaporation to. | Tests used.              | Results.                 |
|---------|----------|------|------|------------------|------------|-----------------|----------------|--------------------|----------------------------|----------------------------|--------------------------|--------------------------|
| 33      | D.       | M.   | 22   | 18th Oct., 1863. | Opium.     | grs. 4 to 1 dr. | 6 drs.         | 12                 | .....                      | .....                      | Condition of the pupils. | No effect on the pupils. |
| 34      | B.       | M.   | 24   | 19th Oct., 1863. |            | "               | 6 drs.         | 12                 | .....                      | .....                      |                          |                          |
| 35      | C.       | M.   | 17   | 14th Nov., 1863. |            | "               | 2 drs.         | 12                 | .....                      | .....                      |                          |                          |

## *Ointments applied to the thorax.*

|    |    |    |    |                   |                |                           |         |    |    |             |                                                                                                                                                                                                                                                                                                                                                          |                                        |
|----|----|----|----|-------------------|----------------|---------------------------|---------|----|----|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 36 | D. | M. | 22 | 23rd Sept., 1863. | Oxide of Zinc. | gr. xii to 1 dr. of lard. | 3½ drs. | 24 | 24 | To dryness. | Heated the residue in a crucible, until reduced to ash, dissolved the ash in dil : HCl, filtered and added to filtrate NH <sub>4</sub> O, NH <sub>4</sub> S, and NH <sub>4</sub> Cl, a greenish precipitate was thrown down and dissolved in dil : HCl, and heated it to boiling, added KO in excess and then passed a strong stream of H S, through it. | No evidence of Zinc could be detected. |
| 37 | B. | M. | 24 | 29th Sept., 1863. |                | "                         | 5 drs.  | 24 | 24 |             |                                                                                                                                                                                                                                                                                                                                                          |                                        |

## EXPERIMENTS ON ABSORPTION BY THE HUMAN SKIN.

*Ointments applied to the thorax (continued).*

| Number. | Subject. | Sex. | Age. | Date.             | Substance. | Strength.                | Quantity used. | Applied for hours. | Urine collected for hours. | Reduced by evaporation to. | Tests used.          | Results.      | REMARKS.                                                                                   |
|---------|----------|------|------|-------------------|------------|--------------------------|----------------|--------------------|----------------------------|----------------------------|----------------------|---------------|--------------------------------------------------------------------------------------------|
| 38      | D.       | M.   | 22   | Sept. 26th, 1863. | Opium.     | 5 gr. to 1 dr. of lard.  | 3 drs.         | 12                 | ..                         | ..                         | State of the pupils. | Not affected. |                                                                                            |
| 39      | B.       | M.   | 24   | Oct. 2nd, 1863.   |            | ..                       | 4 drs.         | 12                 | ..                         | ..                         |                      |               |                                                                                            |
| 40      | F.       | M.   | 38   | Oct. 14th, 1863.  | * Tar.     | 1 oz. Tar to 1 oz. lard. | 2 oz.          | 72                 | 72                         | ..                         | Smell of the urine.  | Positive.     | The urine passed on the 1st day had a stronger tarry smell than either the 2nd or 3rd day. |

\* Applied to the calves of the legs.









